BEFORE THE
FEDERAL COMMUNICATIONS COMMISSION
WASHINGTON D. C. 20554

In the Matter of	)	
	)	
	)	
Amendment of Part 90 of the	)	
Commission's Rules to Adopt	)	PR Docket No. 93-61
Regulations for Automatic	)	
Vehicle Monitoring Systems	)	

To: The Commission

COMMENTS OF THE
TELECOMMUNICATIONS INDUSTRY ASSOCIATION
USER PREMISES EQUIPMENT DIVISION
WIRELESS CONSUMER COMMUNICATIONS SECTION

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SUMMARY

The Wireless Consumer Communications Section ("the Section") of the Telecommunications Industry Association ("TIA") User Premises Equipment Division ("UPED") hereby offers its Comments on the Petitions submitted by a number of parties requesting reconsideration, partial reconsideration, and/or clarification (collectively the "Petitions") on the Report and Order ("Order") adopted by the Commission in the above-captioned proceeding. The Section did not submit a Petition, and would like to commend the Commission on developing a balanced solution to a proceeding characterized by a large number of conflicting interests. However, some of the Petitioners have raised issues that merit reconsideration or clarification, as discussed in these Comments. Other Petitioners have made requests for reconsideration that are supported by flawed arguments, as also discussed herein.

In their Petitions, MobileVision, L.P. ("MobileVision"), Pinpoint Communications, Inc. ("Pinpoint"), and Southwestern Bell Mobile Systems, Inc. ("SBMS") contend that the presumption of non-interference under the conditions detailed in §90.361 should be made "rebuttable." Significantly, AirTouch Teletrac ("Teletrac"), which is the most experienced of the Location and Monitoring Service ("LMS") multilateration interests, made no request to modify or eliminate the provisions of §90.361. Teletrac merely requested clarification on whether those provisions apply to long-range video links. It seems reasonable to assume that if Teletrac believed that the provisions of §90.361 represented a threat to the health of its business, it would have raised objections to them in its Petition. The Section therefore concludes that the objections of MobileVision, Pinpoint, and SBMS are based on faulty assumptions that stem from a lack of field experience, and that the presumption of non-interference under the conditions specified in §90.361 should continue to be non-rebuttable.

Pinpoint criticizes the power vs. height derating formula given in §90.361, claiming that based on the "Hata" propagation model, the power should be reduced more severely as the height of the Part 15 device increases. As shown herein, Pinpoint's argument is based on consideration of only a single case covered by the Hata model. Consideration of a different case would lead to the opposite conclusion; namely, that the power-vs-height rolloff should be less severe than specified in §90.361. Hence, Pinpoint's analysis is incomplete and misleading, and Pinpoint's request should be denied.

The Order allows wideband forward links, but limits their effective radiated power ("ERP") to 30 watts. A number of Petitioners argue that even at this power level, wideband forward links still represent a potential interference threat to other users of the band, and consequently, wideband forward links should not be allowed. The Section agrees. Pinpoint argues that more power should be allowed for wideband forward links, or alternatively, the grandfathering rules should be modified to allow licensing of more base stations in order to achieve the necessary coverage with 30-watt wideband forward links. Pinpoint claims that it cannot realize its required forward link capacity with the spectrum allocated to narrowband, high-power forward links. The Section does not agree. As shown herein, Pinpoint's claimed forward link throughput requirements can be met with a single 250-kHz channel.

The LMS multilateration interests (MobileVision, Pinpoint, SBMS, Teletrac, and Uniplex Corporation) propose new emission mask specifications as alternatives to the provisions of §90.209(m). Their proposed "wideband" specification (for bands B, D, and E) is based on a relaxed version of the emission mask given in §94.71 and §21.106 for digital fixed terrestrial microwave systems. Their proposed specification for the high-power narrowband forward links is a relaxed version of §24.133, which codifies the emission mask for narrowband Personal Communications Services ("PCS"). While the Section takes no position on the suitability of the emission mask given in §90.209(m) for LMS, it believes that if the masks of §21.106, §24.133, and §94.71 are to be considered as alternatives, they should be adopted without modification, for reasons discussed in detail herein.

A number of Petitioners raised concerns about the types of communications that are permissible over LMS systems, given the current language in §90.353(a)(2) and (3). The Section shares those concerns, and urges the Commission to explicitly prohibit any type of communication that would allow general voice or data communications, or messaging, and to make it clear that public switched network-interconnected communications must be limited by the LMS operator, using some technical means, to (1) emergency communication with Public Safety eligibles and (2) system communication necessary to support the location/monitoring functionality. If non-emergency voice communication is not prohibited altogether, there should at least be some minimum delay imposed in "store-and-forward" communication that would effectively prevent that communication being perceived as "real time" (e.g., 10 seconds).

Several Petitioners expressed concerns regarding the potential for interference between Part 15 devices and grandfathered LMS multilateration systems. The Section urges the Commission to make it clear that the provisions §90.205 and §90.361 apply to grandfathered LMS multilateration systems as well to new licensees. Moreover, limitations on the types of permissible communications as discussed above also should apply to the grandfathered systems.

Amtech Corporation ("Amtech") proposes in its Petition that, as an alternative to the 30 watt/15 meter power and height limits for non-multilateration systems, a field strength limit of 90 dBμV/m six feet above ground at a distance of one mile from the transmitter be used. Amtech claims that this field strength level corresponds to that from a 30-watt transmission from an antenna elevated 15 meters above ground. As shown in these Comments, Amtech's analysis is flawed, and the proposed alternative requirement could greatly increase the potential for interference from non-multilateration systems to other users of the band, including Part 15 devices. Amtech's request therefore should be denied.

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COMMENTS

I. INTRODUCTION

1. The Wireless Consumer Communications Section ("the Section")[1] of the Telecommunications Industry Association ("TIA") User Premises Equipment Division ("UPED") hereby offers its Comments on the Petitions submitted by a number of parties requesting reconsideration, partial reconsideration and/or clarification (collectively the "Petitions") on the Report and Order ("Order") adopted by the Commission in the above-captioned proceeding.[2]

2. The Section has actively participated in this proceeding since its inception, and has contributed significantly to its record. The Section's contributions include several detailed technical analyses focusing on the potential for interference between Part 15 devices and the Location and Monitoring Service ("LMS"). The Section therefore believes it is well-qualified to offer Comments on the Petitions,

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1. The Section was formerly known as the TIA Mobile & Personal Communications Consumer Radio Section. The scope of the Section's work program is unchanged.
2. FCC 95-41, Adopted February 3, 1995, released February 5, 1995.

particularly as they relate to potential interference between Part 15 devices and LMS systems.

3. The Section is well aware of the difficult and contentious nature of this proceeding, and commends the Commission for developing a solution that strikes a reasonable balance among the many conflicting objectives of the proceeding's participants. Given these conflicting objectives, it has been clear almost from the outset that it would not be possible for the Commission to conclude the proceeding in a manner that would completely satisfy all parties. The large number of Petitions submitted in response to the Order therefore is not surprising.

4. The Section did not submit a Petition for Reconsideration. However, some of the Petitioners have raised issues that the Section believes deserve reconsideration or clarification, as discussed herein. In addition, other Petitioners have made requests for reconsideration supported by flawed arguments, which are also discussed in these Comments.

II. THE PROVISIONS OF §90.361 PROTECTING PART 15 DEVICES FROM THE PRESUMPTION OF INTERFERENCE SHOULD NOT BE MADE REBUTTABLE

5. In recognition of the increasingly important role of unlicensed devices in providing wireless personal communications, the Commission has adopted the new §90.361 to provide such devices a measure of protection from claims of interference by multilateration LMS providers. In their Petitions, MobileVision, L.P. ("MobileVision"), Pinpoint Communications, Inc. ("Pinpoint"), and Southwestern Bell Mobile Systems, Inc. ("SBMS") contend that the presumption of non-interference under the conditions detailed in §90.361 should be made "rebuttable."[3] SBMS argues that the rebuttable presumption should be structured such that "if actual interference is demonstrated, the Part 15 device must cease operations until such interference can be eliminated."[4] SBMS does not offer an explanation of what constitutes a valid "demonstration" of interference, which could be particularly problematic given the potential for additive interference from multiple transmitters.

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3. See MobileVision at p. 13, Pinpoint at p. 23, and SBMS at p. 9.
4. SBMS at p. 9.

6. Even if some reasonable criteria for demonstrating interference were formulated, it is difficult to see how a "rebuttable" presumption of non-interference differs from a total absence of the provisions of §90.361. Presumably, even without those provisions, the burden of proof would still fall on the LMS operator. Thus, the Section believes that a request to make the non-interference presumption rebuttable is tantamount to a request to eliminate §90.361 altogether.

7. Interestingly, AirTouch Teletrac ("Teletrac"), in its Petition for Partial Reconsideration and Clarification, mentioned §90.361 only to request clarification on whether the provisions apply to Part 15 long-range video links. Teletrac made no request to modify or eliminate §90.361. The Section believes that the lack of an objection to §90.361 by Teletrac is significant because Teletrac is the most advanced of the multilateration system operators in terms of system engineering experience, equipment deployment, system operation, and customer service. It seems reasonable to assume that if Teletrac believed that the provisions of §90.361 posed a threat to the health of its business, it would have requested that they be modified or eliminated. The Section therefore concludes that the objections of MobileVision, Pinpoint, and SBMS are based on faulty assumptions that stem from a lack of field experience. Consequently, the Section believes that the presumption of non-interference should continue to be unconditional, and that the requests of MobileVision, Pinpoint, and SBMS for a "rebuttable" presumption should be denied.

III. PINPOINT'S DISCUSSION OF THE PART 15 POWER/HEIGHT DERATING IS INCOMPLETE AND MISLEADING

8. In §90.361, the height threshold for presumption of non-interference from outdoor Part 15 devices to multilateration LMS systems is 5 meters at full power (up to 1 watt with up to 6 dBi antenna gain). The non-interference presumption can be extended up to a height of 15 meters, provided the transmitted power is reduced below 1 watt by 20 log(h/5) dB, where "h" is the antenna height above ground in meters.

9. Pinpoint takes issue with this power derating formula on the grounds that "the interference potential of Part 15 devices under these new rules increases with

heights above 5 meters because power increases due to height outpaces the regulatory requirement to attenuate power with height."[5] Pinpoint goes on to explain that using the "Hata" model,[6] "going from 5 to 15 meters yields a 26 dB increase in power."[7] The Section feels compelled to point out that this explanation is incomplete and misleading. Secondarily, it violates the limits of the Hata model,[8] and represents an extrapolation.

10. With the Hata model, the input parameters are frequency, base station antenna height, and mobile station antenna height. The model provides formulas for the median path loss in the form $L = A + B \log r$, where "L" is the median path loss in dB and "r" is the distance between the base and mobile. The parameter "A" depends on the frequency, as well as the base and mobile antenna heights, and "B" depends only on the base antenna height. In its analysis, Pinpoint evidently is casting the Part 15 device in the role of the mobile for purposes of applying the Hata model. Clearly, the use of a 15-meter height exceeds the bounds of the model.

11. Notwithstanding the liberties taken with the Hata model by Pinpoint, it should have been noted for completeness that the rate of decrease in path loss, as the mobile height increases, is dependent on the environment. The Hata model provides two different "correction factors" for mobile antenna height: one for the "medium-small city" environment and one for the "large city" environment. These correction factors affect the net value of the "A" parameter, and hence the path loss calculation. For a frequency of 915 MHz, the correction factor for the "medium-small city" environment is about 9 dB for a 5-meter mobile antenna height and 34.5 dB for a 15-meter height. Pinpoint's contention evidently is based on the presumption of a "medium-small" city environment. However, for the "large city" environment, the difference is much less dramatic; about 5 dB for the 5-meter height vs. 11.2 dB for a 15-meter height, or a difference of 6.2 dB, which is less than the 10 dB derating given by the formula in §90.361. Thus, it could be argued that in the "large city" environment, the interference potential of a 15-meter

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5. Pinpoint at p. 22.
6. See M. Hata, "Empirical Formula for Propagation Loss in Land Mobile Radio Services," IEEE Transactions on Vehicular Technology, vol. VT-29, no. 3, August, 1980, pp. 317-325.
7. Pinpoint at p. 22.
8. For the Hata model to apply, the mobile antenna height is restricted to the range 1 to 10 meters, and the base height 30 to 200 meters. See Hata, p. 324.

Part 15 device (with the derating specified in §90.361) is less than that of a 5-meter device.

12. If the stated bounds on the applicability of the Hata model are respected, then the greatest "mobile" antenna height that can be used is 10 meters. In that case, the correction factors are 21.8 dB for the "medium-small" city environment and 8.7 dB for the "large city" environment, which differ from their 5-meter values by about 12.8 dB and 3.7 dB, respectively. For a 10-meter height, the derating formula of §90.361 specifies a 6-dB power reduction, which again falls between the difference in correction factors for the "medium-small city" and "large city" environments, and it might still be argued that the derating formula is too liberal in the one case and too conservative in the other. The Section therefore believes that Pinpoint's arguments for a more severe power-vs.-height derating formula[9] are not valid, and they should be disregarded.

IV. WIDEBAND FORWARD LINKS ARE UNNECESSARY AND POSE AN INTERFERENCE THREAT TO OTHER USERS OF THE BAND, BUT IF THEY ARE ALLOWED, THEY SHOULD BE LIMITED TO 30 WATTS ERP AS SPECIFIED IN THE ORDER

13. The Order allows multilateration systems to use wideband forward links, but limits them to 30 watts effective radiated power ("ERP"). This represents a reduction of roughly 12 dB compared to the 500-watt ERP envisioned by Pinpoint. Although the 30-watt limit reduces the potential of the wideband forward links to interfere with other users of the band, a number of Petitioners requested that wideband forward links be prohibited altogether.[10] Indeed, there are some Part 15 applications that could still suffer significant interference from a 30-watt wideband forward link. Examples include wideband direct-sequence wireless local area networks ("LANs") and outdoor pole- or rooftop-mounted data link receivers. Even a cordless telephone near a 30-watt wideband forward link transmitter could be adversely affected. The Section therefore supports those Petitioners requesting that wideband forward links be prohibited.

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9. See Pinpoint at p. 24.
10. See the Ad Hoc Gas Distribution Utilities Coalition ("Gas Utilities") at pp. 12-14, CellNet Data Systems ("CellNet") at pp. 4-6, Metricom, Inc. and Southern California Edison Company ("Metricom/SCE") at pp. 6-8, the Part 15 Coalition at pp. 4-7.

14. Pinpoint objects to the 30 watt limit, noting that it "planned to use 500 watt ERP base stations to achieve its initial coverage."[11] Pinpoint explains that the 30-watt limit will reduce the range of the forward link by roughly a factor of two, requiring "four times as many base stations to ensure the same system coverage."[12] Pinpoint goes on to explain that under the grandfathering rules of the Order, it cannot build the additional base stations, so either a change to the grandfathering rules or a higher transmit power limit for wideband forward links is necessary.[13]

15. In a footnote, Pinpoint explains that the capacity offered by the 250-kHz high-power forward links authorized in §90.357 is inadequate for its needs,[14] supporting that contention with a reference to an ex parte letter filed shortly before issuance of the Order.[15] As discussed in the attachment hereto, the analysis in that ex parte letter was flawed; based on Pinpoint's own stated forward link data rate and duty cycle parameters (360 kb/s rate and average 30% duty cycle), the net forward link throughput for Pinpoint's system concept is about 120 kb/s. Using Pinpoint's 0.5 bit/sec/Hz net modulation efficiency,[16] the total bandwidth requirement for a non-spread spectrum ("narrowband") forward link is 240 kHz. Hence, Pinpoint's capacity requirements could in fact be met using one of the 250 kHz blocks designated in §90.357. The Section therefore contends that the Commission has provided Pinpoint with a reasonable alternative to its proposed high-power wideband forward links, and concludes that Pinpoint's request for either a higher power limit for wideband forward links, or a modification of the grandfathering rules, should be denied, even if wideband forward links continue to be permitted.

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11. See Pinpoint at p. 14.
12. Id.
13. Pinpoint at pp. 14-15.
14. Pinpoint at p. 15, footnote 26.
15. Ex parte letter of Louis H. M. Jandrell, January 25, 1995.
16. Ex parte letter of Louis H. M. Jandrell, September 15, 1994, pp. 13-14.

V. THE PROPOSED LMS MULTILATERATION EMISSION MASK SPECIFICATIONS ARE FLAWED AND SHOULD NOT BE ADOPTED

16. MobileVision, Pinpoint, SBMS, Teletrac, and Uniplex Corporation (collectively the "LMS multilateration interests") have raised objections to the emission limits in §90.209(m), and have proposed two different alternative specifications:[17] one for "wideband emissions" (bands B, D, and E) and one for the narrowband high-power forward links between 927.25 and 928.0 MHz (bands F, G, and H). These specifications are based on relaxed versions of existing emission specifications for other services in other Parts of the Commission's Rules (in §21.106, §24.133, and §94.71).

17. As discussed in detail infra, upon examining the specifications of §21.106, §24.133, and §94.71 and the proposals of the LMS multilateration interests, the Section finds no valid technical reasons to support the proposed relaxations. The Section takes no position on the suitability of the existing emission mask specification in §90.209(m), and does not presume to propose a specific alternative. However, if the Commission deems it appropriate to adopt specifications based on those of §21.106, §24.133, and §94.71, then the Section does not believe that those specifications should be relaxed for application to LMS multilateration systems, for reasons discussed in detail below.

A. Modification of the Fixed Digital Microwave Specification for Application to "Wideband" Multilateration LMS Links is Not Justified

18. The proposed alternative "wideband" specification is based on §21.106(a)(2) and §94.71(c)(2), which specify identical emission limits for the Domestic Public Fixed Radio Services and the Private Operational Fixed Microwave Service, respectively. To arrive at their proposed wideband specification, the LMS multilateration interests suggest that the limits of §21.106(a)(2) and §94.71(c)(2) be modified in three ways: (1) a 5-dB relaxation of the fixed attenuation in the formula; (2) a halving of the rolloff slope factor; and (3) a measurement bandwidth of 100 kHz rather than the 4 kHz specified in §21.106(a)(2) and §94.71(c)(2), with a corresponding 14-dB reduction in the attenuation formula.

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17. See MobileVision at pp. 9-10 and Annex 1, Pinpoint at pp. 17-20, SBMS at pp. 21-23, Teletrac at pp. 2-8, and Uniplex at pp. 6-7.

19. The Section does not agree with the justification given by the multilateration LMS interests for their proposal. While it might be appropriate to base the limits for LMS wideband emissions on the limits that apply to high-speed digital microwave transmissions, it does not seem reasonable that the LMS specification should be less stringent than the fixed microwave specification.

20. The purpose of out-of-band emission limits is to protect users of adjacent spectrum from interference. In the fixed microwave services, interference among users is prevented not only by technical requirements such as emission masks, but also by path engineering and frequency coordination. Avoidance of interference in the microwave fixed services through coordination of radio link routes and frequencies is possible because of the non-mobile nature of the systems, and the high degree of control over the distribution of radio energy afforded by the highly-directional antennas. Thus, in the fixed services, the emission mask is but one of several tools for preventing interference.

21. With a mobile service such as LMS, base and mobile antennas typically are omnidirectional, and locations of transmitters generally are not bound by any constraints related to their proximity to other users of the band. Consequently, technical specifications such as emission masks and power limits are the primary forms of interference control. The Section therefore is puzzled that the LMS multilateration interests believe that it is appropriate to make the LMS "wideband" emission mask less stringent than the fixed digital microwave requirement.

22. Moreover, the proposal to use a 100 kHz measurement bandwidth rather than the 4 kHz specified in §21.106(a)(2) and §94.71(c)(2) does not seem to be justified by any compelling logic. Teletrac cites "the wide bandwidth requirements" and the "reduced spectral density of LMS signals" among reasons for modifying the specification of §21.106(a)(2) and §94.71(c)(2).[18] MobileVision supports the 100 kHz measurement bandwidth "to accommodate a variety of chipping rates and code sequences."[19] The Section finds these attempted justifications curious, since §21.106(a)(2) and §94.71(c)(2) themselves apply to systems with a wide range of bandwidths and signaling rates.[20] Some of these bandwidths and

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18. Teletrac at p. 6, footnote 17.
19. MobileVision, Annex 1 at p. 1.
20. See, for example, §21.122.

signaling rates are significantly higher than those of the LMS "wideband" signals. For example, fixed digital microwave systems near 4 GHz and 6 GHz can use bandwidths of 20 MHz and 30 MHz, respectively, with corresponding bit rates of roughly 90 Mb/s and 135 Mb/s. Assuming that the standard 64-level quadrature amplitude modulation ("64-QAM") is used, the corresponding radio frequency ("RF") baud rates are 15 Mbaud and 22.5 Mbaud, respectively. By comparison, the maximum LMS bandwidth is 8 MHz (realized by combining bands D, E, F, and G),[21] and the maximum LMS chip rate cited by MobileVision is 5.768 Mcps,[22] for Pinpoint's system. Hence, there does not seem to be a valid justification for modifying the specification of §21.106(a)(2) and §94.71(c)(2) on the basis of the "wideband" LMS bandwidths and chip rates.

B. The Proposed High-Power Narrowband Forward Link Specification is Incomplete

23. For the high-power forward links in bands F, G, and H at 927.25-928.0 MHz, the LMS multilateration interests propose an emission limit based on §24.133. The LMS proposal is that the attenuation, relative to the transmit power ("P"), for a 300-Hz band removed f_d kHz from the band edge be at least 116 $\log_{10}((f_d+10)/6.1)$ dB, or 50 + 10 $\log_{10}$(P), or 70 dB, whichever is the lesser attenuation.[23]

24. Upon review of §24.133, it is clear that this proposal is incomplete. In fact, in §24.133(a)(1)(i), the rolloff specification recommended by the LMS multilateration interests applies to frequencies within 40 kHz of the band edge. For frequencies more than 40 kHz removed from the band edge, §24.133(a)(1)(ii) specifies that the attenuation relative to the transmit power must be 43 + 10 $\log_{10}$(P) dB or 80 dB, whichever is the lesser attenuation. As stated in §24.133(d), the resolution bandwidth for this measurement is to be 30 kHz, rather than the 300 kHz used for emissions within 40 kHz of the band edges.

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21. Order at par. 47.
22. MobileVision, Annex 1 p. 4.
23. See MobileVision, Annex 1 at p. 2, Pinpoint at pp. 17-20, SBMS at pp. 21-23, Teletrac at p. 7, and Uniplex at pp. 6-7.

25. Assuming a 300-watt transmit power, 50 + 10 $\log_{10}$(P) exceeds 70 dB. The rolloff formula 116 $\log_{10}((f_d+10)/6.1)$ dB equals 70 dB when f_d is roughly 15 kHz. Therefore, for frequencies more than about 15 kHz from the band edge, the required attenuation would be 70 dB for any 300-Hz band, under the proposal offered by the LMS multilateration interests. This means, for example, that the out-of-band transmitted power from a 300-watt forward link, within any 100-kHz band, could be as high as 10 dBm. For purposes of comparison, this is roughly 13 dB above the maximum ERP allowed for Part 15 devices operating under §15.249.[24]

26. If the complete specification in §24.133 is used, the required attenuation for frequencies more than 40 kHz from the band edge would be 67.8 dB relative to the transmit power, but in this case measured over a 30-kHz band, which makes a 20-dB difference compared to a 300-Hz measurement bandwidth. This portion of the requirement gives low-power devices using the band an additional 17.8 dB of protection against out-of-band interference power from LMS multilateration system forward links.

27. It is unclear why the LMS multilateration interests elected to omit the "outer" out-of-band specification in §24.133(a)(1)(ii); perhaps it was simply an oversight. However, in the Section's view, if §24.133 is to be used as a model for the out-of-band emission specification for multilateration LMS forward links, it is essential that the entire specification of §24.133(a)(1) be used, including the measurement bandwidths specified in §24.133(d).

VI. IT SHOULD BE MADE CLEAR THAT NON-EMERGENCY MESSAGING AND VOICE COMMUNICATION ARE STRICTLY PROHIBITED

28. In §90.353, the Order allows the transmission of voice and non-voice "status and instructional messages, so long as they are related to the location or monitoring functions of the system," and allows interconnection to the public switched network ("PSN") "only to enable emergency communications."[25] In

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24. §15.249 allows a maximum field strength of 50 mV/m, measured 3 meters from the source. Assuming an antenna gain of 1.5 (1.76 dB), this corresponds to a radiated power of about 1/2 mW, or -3 dBm.

25. Order, p. 61.

addition, the text of the Order allows "store and forward" interconnection.[26] A number of Petitioners observed that these provisions are sufficiently broad to allow the services provided by an LMS operator to exceed the intent of the Rules.[27] The Section agrees with the concerns expressed by these Petitioners regarding the potential for abuse of the provisions allowing status and instructional messages, emergency interconnection, and store-and-forward interconnection.

29. While the Section agrees with the Commission that provisions are needed for emergency communication, as well as messaging to support the locating functions, it also believes that the language of the Rules is sufficiently vague to allow the potential for abuse, and should be modified to prevent LMS operators from offering services that can be used for general purpose messaging and mobile telephony. The transmission duty cycles associated with those functions tend to be significantly higher than the duty cycles of transmissions used for pure locating/monitoring functions, and would lead to increased levels of interference with other users of the band. Hence, to maximize the likelihood of successful sharing, the Section believes that the use of the band by LMS operators should be explicitly restricted to operations directly associated with LMS. This objective could be achieved with a few minor modifications to the current Rules.

30. One such modification, as suggested by CellNet, is for §90.353)(a) to "expressly state that general messaging services are prohibited."[28] This prohibition should include such things as paging services and voice "mailbox" messaging. Moreover, it should be made clear that the allowed "status and instructional messages" are only those necessary to support the actual locating/monitoring operations, and are restricted to "system" messages, rather than messages initiated by the end user. The exception to this would be emergency communication. While §90.353(3) stipulates that interconnected emergency communications "be sent to or received from a system dispatch point or entities eligible in the Public Safety or Special Emergency Radio Services," it is unclear whether the burden of adhering to this restriction falls on the LMS operator

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26. Order at par. 27.

27. See the Utilities Telecommunications Council ("UTC") at pp. 2-11, Gas Utilities at pp. 15-17, the Connectivity for Learning Coalition ("Learning Coalition") at pp. 11-13, CellNet at pp. 9-13, Metricom/SCE at pp. 13-15, the Part 15 Coalition at pp. 7-12, and SBMS at pp. 9-11.

28. See CellNet at p. 10.

or the end user. If it is the latter, the potential for abuse exists, as pointed out by the Part 15 Coalition.[29] The Section therefore believes that it must be made clear that the LMS operator must establish a mechanism for ensuring that the restriction of §90.353(3) cannot be violated by the end user. This mechanism must be an integral part of the LMS system, because, as noted by a number of Petitioners, enforcement of the restriction by monitoring communication is impractical.

31. As pointed out by SBMS, the "store-and-forward" limitation for non-emergency interconnected communication is not meaningful without a definition of "store-and-forward".[30] SBMS correctly notes that digital cellular systems could be construed as satisfying the store-and-forward requirement, since digitized voice samples are stored for a short time prior to transmission.[31] To the user, however, the delay is imperceptible and the communication appears instantaneous. Therefore, the Section believes that if interconnected store-and-forward communication is to be allowed, a minimum storage interval should be imposed as suggested by the Part 15 Coalition.[32] The required interval should at least be long enough to prevent the communication from being perceived as "real time" (such as ten seconds).

32. Notwithstanding the possibility of preventing regular use of the LMS frequencies for real-time voice communication with a minimum storage interval, the Section believes that it would be preferable to prohibit interconnected communication altogether (other than emergency communication and that necessary to support locating/monitoring system functions). Even a true store-and-forward interconnection capability could be used for voice messaging, which clearly is beyond the intended scope of LMS. Therefore, the Section urges the Commission to explicitly prohibit any type of communication that would allow general voice or data communications or messaging, as suggested by CellNet,[33] and to make it clear that PSN-interconnected LMS communications must be limited by the LMS operator, using some technical means, to (1) emergency communication with Public Safety eligibles and (2) system communication necessary to support the locating/monitoring functionality.

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29. See Part 15 Coalition at p. 10.
30. SBMS at pp. 9-10.
31. Id.
32. Part 15 Coalition at pp. 11-12.
33. CellNet, p. 10.

VII. IT SHOULD BE CLARIFIED THAT THE PROVISIONS OF §90.205 AND §90.361 APPLY TO GRANDFATHERED LMS MULTILATERATION SYSTEMS AS WELL AS TO NEW LICENSES

33. Concerns were expressed by several Petitioners regarding the potential for interference between grandfathered LMS multilateration systems and Part 15 devices.[34] The Section shares those concerns and agrees that the Commission should make it clear that the provisions of §90.205 and §90.361 apply to LMS systems that are grandfathered under the provisions of §90.363. Moreover, the Section believes that the provisions of §90.361 should apply to all multilateration LMS systems, as of the effective date of the new Rules. As articulated by Metricom/SCE, the policy reflected by the new Rules adopted in the Order "is as much in the public interest now as it will be when current systems convert their AVM [Automatic Vehicle Monitoring] licenses to LMS licenses." [35]

VIII. AMTECH'S PROPOSED MODIFICATION TO THE NON-MULTILATERATION POWER/HEIGHT LIMITS IS BASED ON A FLAWED CONCEPT AND COULD SIGNIFICANTLY INCREASE THE POTENTIAL FOR INTERFERENCE FROM NON-MULTILATERATION SYSTEMS

34. Amtech Corporation ("Amtech") proposes that, as an alternative to the 30 watt/15 meter non-multilateration power/height limits in §90.205 and §90.353(a)(8), respectively, the electric field strength be limited to 90 dBμV/m at a distance of one mile from the transmitter and a six-foot elevation.[36] Amtech contends that this limit "would result in a field strength equivalent to that which would be produced by a facility operating at 30 watts ERP from a height of 15 meters above the ground." [37] As shown below, Amtech's claim is technically incorrect and conceptually simplistic.

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34. See Gas Utilities at pp. 9-12, Part 15 Coalition at pp. 12-13, Metricom/SCE at pp. 15-16, Learning Coalition at pp. 14-15, CellNet at pp. 6-7.

35. Metricom/SCE at p. 16.

36. See Amtech, p. 12.

37. Amtech at p. 12, footnote 21.

35. The computation of field strength at a particular distance from a radiating antenna of a given height and ERP depends on the propagation model used. If the "free-space" propagation model is used, the field strength one mile from a 30-watt ERP radiator would be about 87.6 dBμV/m (if the free-space model is used, the antenna elevation is irrelevant). Presumably, Amtech's 90 dBμV/m is based on a rounding-up of this free-space calculation.

36. It is well known that the free-space model does not in general accurately represent propagation between antennas in a real-world terrestrial environment. A better theoretical approximation would be the "smooth earth" model, which takes into account the phase relationship of the direct and ground-reflected electric fields, and yields the resultant field as the complex phasor sum of the two.[38] With the smooth-earth model, the field strength six feet above the ground and a mile away from a 30-watt ERP transmitter 15 meters above ground would be roughly 83.4 dBμV/m. It would require more than 135 watts ERP to produce a field of 90 dBμV/m.

37. However, even the smooth-earth model does not accurately represent propagation paths subject to multiple reflections and losses associated with penetration through, and diffraction around, obstructions (buildings, trees, etc.). For such paths, an empirically-derived model such as the Hata model should be consulted. Extrapolating the Hata model to use a base antenna height of 15 meters,[39] the median received field strengths one mile from the transmitter, at a height of six feet, are: 74.4 dBμV/m for the "open area" environment; 55.8 dBμV/m for the "suburban" environment, and 45.7 dBμV/m for the "urban" environment.[40]

38. It is clear from these results that Amtech's claim of equivalence between the proposed 90 dBμV/m field strength limit and the existing 30-watt ERP/15 meter elevation limit is not only inaccurate, but simplistic as well. The received field strength clearly will depend on the environment. Moreover, it should be kept in

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38. See E. K. Jordan and K. G. Balmain, Electromagnetic Waves and Radiating Systems, second edition, Prentice-Hall, 1968, chapter 16, for details on the effect of the ground reflection.

39. As noted above, the lower limit on base height for which the Hata model is stated to apply is 30 meters. Thus, strictly speaking, a 15-meter height falls outside the parameters bounds of the Hata model and represents an extrapolation.

40. For a six-foot elevation of the receiving antenna, the urban "large city" and "medium-small city" path losses given by the Hata model differ by only 0.14 dB.

mind that the Hata model gives the median path loss, and therefore the median field strength. The actual field strength measured at any particular point six feet above ground and one mile from the transmit antenna will vary randomly (and over a considerable dynamic range) due to multipath and shadowing effects. A statistically valid characterization of the median field strength would require multiple measurements at different locations on a one-mile circle centered on the transmitter, followed by analysis to determine the desired parameters (mean, median, standard deviation, etc.) Thus, a meaningful process to verify compliance with Amtech's proposed field strength criterion would be complicated at best, and impractical to enforce.

39. It is also clear that Amtech's proposed field strength criterion would in some cases allow extremely high power levels to be used. For example, with the Hata model in the "open area" environment, the field strength at one mile (and a six-foot elevation) from a 30-watt ERP transmission is 74.4 dBμV/m as discussed above. This is 15.6 dB below Amtech's proposed 90 dBμV/m limit. Thus, a transmission 15.6 dB above 30 watts ERP, or more than 1000 watts would still meet Amtech's proposed limit. If the Hata "suburban" and "urban" environments are considered, the allowed power levels could be higher.

40. If the antenna pattern of the non-multilateration system is aimed upward or downward rather than horizontally, as Amtech indicates is often the case,[41] the energy directed at the field point (the point one mile from the antenna and six feet above the ground) could be attenuated considerably by the antenna pattern, as also noted by Amtech.[42] This would allow further increases in the transmitted power while still meeting Amtech's proposed criterion, and would correspondingly increase the potential interference threat to Part 15 consumer devices, including cordless telephones. Consider, for example, the rail-car monitoring example described by Amtech in which a high-gain antenna is ground-mounted with its pattern directed upward.[43] Amtech's proposed field strength criterion would allow considerable power to be radiated with this arrangement, because only a very small fraction of the energy would be directed at the field point. However, the interference generated to elevated systems (such as cordless telephones and

41. See Amtech, pp. 10-11.
42. Amtech at p. 11.
43. Id.

wireless local area networks in high-rise apartments or office buildings) could be overpowering.

41. The Section concludes, for the reasons given above, that Amtech's proposal could lead to increased interference levels from non-multilateration systems to Part 15 devices, including such widespread applications as cordless telephones and automated meter reading systems. Amtech's request should be denied, and the non-multilateration height and power limits should remain at 15 meters and 30 watts ERP, respectively, as specified in the Order.

IX. CONCLUSION

42. The Section would again like to commend the Commission on developing a well-balanced solution to a difficult proceeding. Although the Section did not submit a Petition for Reconsideration, it believes that the public interest would be served by reconsideration or clarification of several points raised in the Petitions, as discussed herein.

Respectfully submitted,

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ATTACHMENT

Introduction

In a January 25, 1995 *ex parte* letter ("the Jandrell letter"), Mr. Louis H. M. Jandrell of Pinpoint Communications, Inc. responded to several previous *ex parte* filings, focusing on topics related to the reverse link bandwidth and justification of wideband forward links for multilateration Location and Monitoring Service (LMS).[1] The purpose of this attachment is to address the discussion in that letter relating to the use of wideband forward links.

Narrowband vs. Wideband Forward Links

Mr. Jandrell states that the capacity of Pinpoint's 8 MHz wideband forward link is 360 kb/s.[2] It should be kept in mind, however, that this is the *instantaneous data rate,* not the net throughput. The distinction is important because the wideband forward link shares spectrum on a time-division basis with the reverse link; on the average, the wideband forward link is "on the air" only about one-third of the time. Thus, the forward link *throughput* is on the order of 120 kb/s for a loaded system. A narrowband forward link in a band separate from the reverse link would have access to the band on a continuous basis, and therefore would not require the 360 kb/s rate.

In Pinpoint's design concept, a single wideband forward link is dynamically time-shared among roughly 30 to 35 base stations, so each base station has access to the forward link about 3% of the time, on average. Hence, the average throughput per base is three percent of 120 kb/s, or 3.6 kb/s. This calculation agrees with Pinpoint's claim that each base is active on the forward link only 1% of the time, on average.[3]

At this point, it is enlightening to examine the arguments given in the Attachment to the Jandrell letter, which states:

> In actual operation, traffic on a *fully subscribed* system is likely to use only a small fraction of the 100% "theoretical" capacity. This apparent reduction is to allow for transient peak loading without causing significant increases of latency delay. Therefore, the *busiest* base

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[1]Letter from Louis H. M. Jandrell, Vice President Design & Development, Pinpoint Communications, Inc., to William F. Caton, Acting Secretary, FCC, dated January 25, 1995.

[2]Jandrell letter at p. 4.

[3]Attachment to Jandrell letter, p. 2.

> station is likely to have an *average transmit duty factor of less than 3%,* even when the busiest base station carries 10 times the load of the average least busy base stations. Allowing further that transient peaks in message-radiolocation traffic are three times that of the average traffic, would still mean that the busiest station would be transmitting, transiently, with *peak duty factors* of less than 10%. We must reiterate that these values of airtime duty factors are based on the "theoretical maximum" values, only practically achievable under "diagnostic" conditions and theoretical-maximum demand [emphasis in original].[4]

For a 360 kb/s time-shared forward link, a 10% peak duty factor corresponds to a peak throughput of 36 kb/s. This, presumably, is the upper bound on the instantaneous forward link capacity required at any given base station, even under the extreme conditions of loading and usage peaking described above. A single narrowband forward link with a 120 kb/s peak capacity could be time-shared among all base stations. Given the statements about loading and peaking provided in the Attachment to the Jandrell letter, it is evident that such a solution should be sufficient to meet the traffic capacity needs envisioned by Pinpoint. Using Mr. Jandrell's rule-of-thumb 0.5 bit/sec/Hz net modulation efficiency,[5] the corresponding bandwidth requirement is 240 kHz. Thus, a channel of 250 kHz bandwidth, such as those allocated by the Commission in the *Order*, will be able to accommodate Pinpoint's envisioned forward link capacity.

This spectrum requirement contrasts markedly with Mr. Jandrell's overstated 1.6 MHz bandwidth requirement for narrowband forward links to support Pinpoint's system concept.[6] Mr. Jandrell's assessment suffers from two errors. First, he neglected to account for the fact that a forward link in a separate band would not be limited to roughly one-third the total air time, as is Pinpoint's current time-shared forward link concept.[7] Second, he arbitrarily doubled the number of forward link channels required to account for "Rayleigh fading."[8] He seems to ignore the fact that there are very effective countermeasures for multipath fading that can be used on narrowband channels (*i.e.*, diversity and adaptive equalization), which are in fact used today in digital cellular systems, including

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[4] *Id.*

[5] Louis H. M. Jandrell, *ex parte* letter, September 15, 1994.

[6] Jandrell letter at pp. 4-5.

[7] It is also interesting to note that Mr. Jandrell's footnote 11 (p. 5) results from the same lapse, stating that a (continuously-available) 250 kb/s narrowband forward channel provides only 70% of the capacity of the wideband 360 kb/s channel. This clearly is untrue, since the wideband forward link must time-share its band with the reverse link.

[8] Jandrell letter at p. 4.

the GSM[9] system mentioned by Mr. Jandrell. In fact, in his discussion of GSM, Mr. Jandrell inadvertently provides an "existence proof" that a single channel of 250 kHz bandwidth can indeed accommodate Pinpoint's required 120 kb/s throughput. Mr. Jandrell observes that for a single GSM frequency channel, which is 200 kHz wide, "the effective throughput is approximately 96 kbps."[10] Multiplying the bandwidth ratio 250/200 (=1.25) by 96 kb/s gives exactly 120 kb/s. Since the GSM air interface was designed to operate under the same conditions as Pinpoint's system (high-speed mobility with severe multipath fading in large cells), this calculation suggests that the same techniques used by GSM to combat the resulting signal impairments could be effectively used by Pinpoint to achieve its forward link capacity in a 250 kHz bandwidth.

In summary, Mr. Jandrell has grossly overstated the spectrum requirements for implementing the forward link using a narrowband approach. His analysis is inconsistent with the information on loading and traffic peaking factors in the Attachment to his own letter, and as has been shown here, Pinpoint's stated forward link throughput requirements can be met using a narrowband approach, within the 250 kHz bandwidth of a single "narrowband" forward link channel.

The Interference Potential of the Wideband Forward Link

Mr. Jandrell argues that Part 15 concerns about interference from the wideband forward link are unfounded. He first makes the point that during off-peak operation, the activity factor of a base station would be lower than 1%[11] and criticizes an analysis of the interference potential[12] for using the 1% figure instead of some lower number. It would seem rather obvious that the severity of the interference will vary with the activity of the base station; however it would also seem reasonable to analyze the potential for interference in a situation representing a mature market. Mr. Jandrell claims that the use of the 1% transmit duty factor per base in the analysis "materially exaggerates the interference Part 15 systems might receive."[13] It could also be argued, however, that the use of the average activity factor actually *understates* the level of interference that will be received by Part 15 devices near an unusually busy base station.

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[9]GSM stands for "Global System for Mobile Communications" and is the Pan-European digital cellular standard, operating near 900 MHz.

[10]Jandrell letter at p. 4, footnote 8.

[11]Jandrell letter at pp. 5-6.

[12]J. E. Padgett, "Response to Pinpoint's Comments on 'Wide Area Pulse-Ranging AVM/LMS: Messaging/Locating System Design Tradeoffs and Part 15 Interference'," *ex parte* letter, November 30, 1994.

[13]Jandrell letter at p. 6.

Mr. Jandrell also mentions the possibility of aggregating each base station's transmissions (*i.e.*, queuing poll requests for a given base and transmitting them in batches) to make them more readily detectable to Part 15 devices than the current isolated short (200 microsecond) bursts. If done correctly, it could have the desired effect, but it would still cause interference and also would have the effect of "chasing" adaptive Part 15 devices away from the part of the band used by the wideband forward link. In other words, Part 15 devices would be deprived of roughly 30% of the band (assuming an 8 MHz wide forward link).[14] This would seem to be difficult to justify in light of the fact that Pinpoint's desired functionality can be achieved without using the wideband forward link.

Finally, Mr. Jandrell dismisses an analysis of wideband forward link interference to cordless telephones[15] as "largely irrelevant."[16] The reasons he gives for this assessment suggest that he has lost the thread of the argument that runs through the series of *ex parte* filings discussing this topic, and that he did not carefully review the analysis. Initially, some path loss calculations were provided by Part 15 interests to estimate the interference potential of wideband forward links, assuming a 300 foot antenna elevation and 5 kW ERP.[17] In his September 15 letter, Mr. Jandrell responded that the elevation should be 200 feet and the power 500 W ERP, revised the interference calculations accordingly, and stated as follows:

> the reduced effective range of the wideband forward link results in the noise floor being raised to -95 dBm only 5.4% of the time in a 100 kHz bandwidth throughout an 8 MHz sub-band at a receiver 30 feet above ground level. At 6 feet above ground level, the Pinpoint occupancy of the 8 MHz band is down to 1%.[18]

In other words, a device 6 feet above the ground will be able to "hear" only a single Pinpoint base station. It was the implication that interference 1% of the time is essentially a "non-problem" that prompted the more detailed investigation into the ***effect*** of the interference that was reported in the subsequent analysis criticized by Mr. Jandrell. At that point, propagation was not at issue. Rather, the

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[14]It is worth noting that contrary to the implication on p. 6 of the Jandrell letter, the possibility of aggregating wideband forward link transmissions was in fact discussed in the Padgett *ex parte* letter of November 30 (p. 13).

[15]J. E. Padgett, "Collision Analysis for Frequency Hopping Cordless Telephones with Adaptive Hopping Sequences," attached to the Padgett *ex parte* letter of November 30, 1994.

[16]Jandrell letter at p. 6.

[17]J. E. Padgett, August 12, 1994, pp. 34-35.

[18]L. H. M. Jandrell, September 15, 1994, p. 16.